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Researching ecosystems in innovation contexts

Erkko Autio
Imperial College Business School, London, UK, and
Llewellyn D.W. Thomas
IESE Business School, Barcelona, Spain

Abstract

Purpose – The rapid adoption of the ecosystem concept in innovation contexts has led to a proliferation of differing uses. Scholars need to be crystal clear which concept of the ecosystem they are using to facilitate communication between scholars and allow for cumulativeness and creativity. This paper aims to introduce some clarity into the conceptual mist that surrounds the notion of "ecosystems" in innovation contexts.
Design/methodology/approach – A review of the extant literature on ecosystems in innovation contexts to derive an integrated approach to understanding the variety of constructs in use.
Findings – This paper introduces clarity into the conceptual mist that surrounds the term "innovation ecosystem", showing there are three basic types of ecosystems, all of which have a common focus on the collective production of a coherent system-level output.
Originality/value – Contributes through a comprehensive overview of the differing ecosystem types in innovation contexts and with a heuristic to disambiguate types of innovation ecosystems.

Keywords Ecosystem, Entrepreneurial ecosystem, Business ecosystem, Innovation ecosystem, Urban ecosystem, Industrial ecosystem

Paper type Conceptual paper

Introduction

The concept of an "ecosystem" describes organic constellations of organizational participants that collectively cocreate ecosystem-level outputs (Adner, 2017; Autio, Nambisan, Thomas, & Wright, 2018; Järvi, Almpanopoulou, & Ritala, 2018). The ecosystem concept has been adopted by a wide variety of scholarly perspectives, such as industrial engineering (Frosch & Gallopoulos, 1989), urban planning (Decker, Elliott, Smith, Blake, & Rowland, 2000), economics (Seppelt, Dormann, Eppink, Lautenbach, & Schmidt, 2011), entrepreneurship (Autio *et al.*, 2018), innovation management (Järvi *et al.*, 2018) and strategy (Adner, 2017; Jacobides, Cennamo, & Gawer, 2018). Innovation scholars have also variably adopted derivative concepts such as "innovation ecosystems", "business ecosystems", "technology ecosystems", "platform ecosystems", "industrial ecosystems", "urban ecosystems", "civic ecosystems", "open innovation ecosystems", "entrepreneurial ecosystems" and "knowledge ecosystems" – often without explicit definition and significant overlap (Thomas & Autio, 2020). What these derivative concepts have in common is a novel coordination solution to collective production of a coherent system-level output, complemented with associated benefits for individual ecosystem stakeholders (Cao, Autio, & Thomas, 2021; Thomas & Autio, 2020).

While conceptual variety does not necessarily signal confusion, and some variance is both to be expected and may not necessarily be contradictory (Whetten, Felin, & King, 2009), the

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rapid adoption of the ecosystem concept in various disciplines and diverging levels of analysis has the potential to confuse. As an ecosystem is a conceptual abstraction of a phenomena that cannot be directly observed (MacCorquodale & Meehl, 1948), and which attempts to "*distil [the] phenomena into sharp distinction that are comprehensible to a community of researchers*" (Suddaby, 2010, p. 346), it requires clarity to be comprehensible. This is particularly important for scholars who wish to build theory using ecosystems, given that theory is a "*system of constructs [. . .] which [. . .] are related to each other*" (Bacharach, 1989, p. 498). In this paper, we argue that scholars need to be crystal clear which concept of the ecosystem they are using so as to facilitate communication between scholars and allow for cumulativeness and creativity (Suddaby, 2010). Our objective in this short paper, therefore, is to introduce some clarity into the conceptual mist that surrounds the notion of "ecosystems" in innovation contexts.

What is an ecosystem?

In biology, an ecosystem is "*a biotic community or assemblage and its related physical environment in a particular place*" (Tansley, 1935), a nonequilibrium thermodynamic system which focuses on the processing, partitioning and dissipation of energy between ecosystem participants, and their consequent interdependence (Golley, 1993; Pickett & Cadenasso, 2002). Biological ecosystems are also scale independent, in that they can be any size where there are living organisms, physical environment and interactions between them (Pickett & Cadenasso, 2002). Consequently, the biological conception of the ecosystem has been adopted by scholars in engineering and the social sciences who have also been interested in participant interdependencies. For instance, "industrial ecosystems" focus on *flows of energy and materials* between industrial organizations within specific geographic regions (Korhonen, 2001). Similarly, "urban ecosystems" consider the interdependences between participants in urban environments (Bai, 2016; Decker *et al.*, 2000). Relatedly, economics considers "ecosystem services" as the benefits that humans obtain from urban and biological ecosystems (Lovell & Taylor, 2013; Pickett & Cadenasso, 2002).

Management scholars, aligned with their interest in economic communities, have (mostly) considered *flows of knowledge* and *flows of value*. Thus, for instance, for strategy scholars, an ecosystem is a multistakeholder venue where flows of value result in coproduction of a product or a service (Adner, 2017; Jacobides *et al.*, 2018). Others have considered how ecosystem participants can cultivate a shared knowledge base regarding "what works" in harnessing advances in digital technologies and infrastructures (Autio *et al.*, 2018; Isenberg, 2010; Spigel, 2017). Still yet others have considered the creation of research-based knowledge and associated applications, reflecting the increasingly open processes of R&D and innovation (Bogers *et al.*, 2017; Järvi *et al.*, 2018; Von Hippel, 2007).

While the above variety of ecosystems of all reflect different phenomena, we suggest that the key distinguisher of ecosystems relates to their governance: ecosystems collectively deliver a system-level output to defined audiences (Thomas & Autio, 2020), and they do so by sidestepping the principal–agent challenge. Ecosystems manage to coordinate the actions of many without resorting to formal, one-to-one supplier contracts that define delivery obligations and possible sanctions should the supplier fail to deliver. Instead, the ecosystem in management theory is a digital-era resolution of the collective action problem, where multiple stakeholders voluntarily come together to collectively deliver a system output without resorting to predefined agreements regarding who should do what, when and how. Ecosystems manage to coordinate and channel the efforts and outputs of many and distribute benefits equitably enough for the stakeholders to voluntarily choose to continue their participation.

How are ecosystems distinct?

Ecosystems are distinct from other collective constructs – such as supply chains, clusters, organizational fields and networks – through four main characteristics: the system-level outcome, participant heterogeneity, nature of interdependencies and coordination mechanisms. While none of the four characteristics alone uniquely distinguishes ecosystems from other organizational collectives, the combination of the four characteristics is unique to ecosystems, and individual characteristics also help distinguish between different types of ecosystems.

System-level outcome

Different from conventional organizational networks, ecosystems are networks that create a coherent *system-level outcome*, in the sense that the ecosystem produces a system-level outcome that is both coherent and greater than any single participant can deliver alone (Decker *et al.*, 2000; Korhonen, 2001; Thomas & Autio, 2020). While a system-level output also characterizes supply chains, these are produced to a predefined design and governed through supplier-specific formal contracts. Ecosystems manage to sidestep the agency problem characteristic of principal–agent relationships and yet produce a coherent, system-level outcome. Thus, for location-specific ecosystems, this may take the form of sustainable industrial production (Korhonen, 2001) or urban amenity (Bai, 2016). Alternatively, the system-level output may take the form of products and services that are compatible with one another, often adhering to a modular product architecture that allows the user to assemble a customized composition of modules to suit individual preferences. Another ecosystem output comprises innovative business models – an output that characterizes entrepreneurial ecosystems in particular (Autio, Cao, Chumjit, Kaensup, & Temsiripoj, 2019; Autio *et al.*, 2018). Yet another ecosystem output comprises generic knowledge production. In "knowledge ecosystems", participants interact so that there is "*collaborative exploration of new knowledge as central activity and output*" (Järvi *et al.*, 2018, p. 1524). However, generally speaking, ecosystems coordinate the actions of many to create a system-level output that none of its participants could generate alone, without resorting to contractual coercion, but rather, motivation and persuasion.

Heterogeneous participants

Ecosystems are composed of *heterogenous communities of stakeholders* that are hierarchically independent but adhere to *specific roles* within the ecosystem (Korhonen, 2001; Thomas & Autio, 2020). Although participant heterogeneity may characterize also other clusters of organizations such as supply chains, the participant heterogeneity exhibited by ecosystems is often broader and can span multiple industries (Autio *et al.*, 2018; Jacobides *et al.*, 2018; Moore, 1993). The types of participants can vary by system level output. For instance, industrial ecosystems can include manufacturers, service providers, resource providers, and utilities (Hess, 2010; Korhonen, 2001; Lifset & Graedel, 2002; Lowe & Evans, 1995), and urban ecosystems include local government, city government, transportation authorities, service providers, and consumer-citizen residents (Bai, 2016). For flow of value contexts, Iansiti and Levien (2004) described an ecosystem as including the loose networks of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and others. Others have specifically included customers in their ecosystem community e.g. Autio and Thomas (2014). Others have included competitors; Moore (1996) included competitors in his original definition, as has much of the "*open innovation ecosystem*" literature (Bogers *et al.*, 2017; Frankort, 2013). Yet others have considered non-market participants, such as universities and public research institutions (Clarysse, Wright, Bruneel, & Mahajan, 2014; Järvi *et al.*, 2018; van der Borgh, Cloodt, & Romme, 2012), and governmental

organizations, such as regulatory authorities, standard-setting bodies, and the judiciary (Autio, Kenney, Mustar, Siegel, & Wright, 2014; Garnsey & Li, 2013; Teece, 2007).

Interdependence

The heterogenous participants within ecosystems are *linked through interdependencies*, such as physical interconnection, spatial proximity, technological complementarities, economic links, shared cognitive templates, technical interconnectedness of products and services and the mutual codependence on direct and indirect network effects (Adner, 2017; Autio *et al.*, 2018; Decker *et al.*, 2000; Järvi *et al.*, 2018; Korhonen, 2001; Thomas & Ritala, 2021). This interdependence is different from that which characterizes networks and supply chains. One type of interdependence is *technological*, in that the heterogeneous participants within the ecosystem are cospecialized, sometimes around a unique resource, shared platform or a common modular architecture (Adner, 2012; Autio *et al.*, 2018; Decker *et al.*, 2000; Jacobides *et al.*, 2018). Often this independence coincides with role dependence, where the roles are organized around the system outcome. A second type of ecosystem interdependence is *economic*, in that the value that each member receives from participating in the ecosystem is dependent on the simultaneous availability of compatible offerings by others, as would be the case of indirect network effects. Economic interdependencies can occur when the ecosystem enables economies of scale and scope (Autio *et al.*, 2018; Bonato & Orsini, 2018; Jacobides *et al.*, 2018; Thomas, Autio, & Gann, 2014) and there are externalities, "*when the actions of one agent affect the interests of another agent other than by affecting prices*" (Davis & North, 1970, p. 134). A third type of interdependence is *cognitive*, in the sense that ecosystem participants have a set of "*socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules [. . .] which provide the formal and informal rules of action, interaction, and interpretation that guide and constrain decision makers*" (Thornton & Ocasio, 1999, p. 804). Cognitive interdependence is particularly important in promoting ecosystem cohesion when the ecosystem participants are heterogeneous, and each participant may adhere to specific world and economic views that are not necessarily widely shared with others within the ecosystem.

Coordination

Ecosystems have distinctive *coordination mechanisms* that rely primarily on role definitions, complementarity and technological, economic and cognitive alignment structures that strike a balance between change and stability (Autio & Thomas, 2018; Gulati, Puranam, & Tushman, 2012; Jacobides *et al.*, 2018; Wareham, Fox, & Cano Giner, 2014). In contrast to supply chains, ecosystems rely primarily on noncontractual mechanisms such as role definitions, supermodular complementarity and role coalignment to strike a balance between efficiency and coherence in ecosystem outputs. Instead of one-to-one supplier contracts that define contributory obligations, ecosystems maintain coherence through the definition of ecosystem roles that define normative expectations to guide expected behaviors. Ecosystem participants choose to join the ecosystem in specific roles, in the knowledge that if they violate associated role expectations, they may be shunned. Often, stakeholders join the ecosystem under one-to-many licensing conditions, such as when connecting to a platform, for example, under which the choice to join the ecosystem signals agreement to adhere to specific conditions. An ecosystem coalignment structure reflects both the interdependencies that typify an ecosystem and power relations between its constituents. In particular, ecosystems that feature strong technological interdependence often employ technological architectures and platforms as their coalignment structure (Wareham *et al.*, 2014), while other types of ecosystems (e.g. entrepreneurial, knowledge, industrial and urban) may emphasize economic or cognitive coalignment structures (Autio & Thomas, 2018; Järvi *et al.*, 2018).

Ecosystem coalignment structures also reflect power relationships within the ecosystem or its stratification (Gulati *et al.*, 2012).

What types of ecosystems are there?

Flow of materials and energy

One type of ecosystems that is currently being investigated by management scholars are those who consider the flow of materials and energy within the physical environment (see Table 1). These types of ecosystems are increasingly being researched by scholars focusing on smart cities, sustainability and circular economy (Aarikka-Stenroos, Ritala, & Thomas, 2021; Ingstrup, Aarikka-Stenroos, & Adlin, 2021).

Industrial ecosystems. Industrial ecosystems are geographically bound industrial systems within which material and energy flows give rise to a sustainable industrial product as a system-level output (Frosch & Gallopoulos, 1989). As biological ecosystems are especially effective at recycling resources, these ecosystems use nonhuman "natural" ecosystems as models, which are considered exemplars of efficient cycling of materials and energy, for industrial activity (Hess, 2010; Morris, Weissburg, & Bras, 2018). Industrial ecosystems are location-specific, in that they are focused on developing closed-loop systems that recycle matter in industrial parks or regions (Korhonen, 2001; Lowe & Evans, 1995).

Urban ecosystems. Urban ecosystems comprise the built environment and infrastructure within which energy and material flows occur. Although many of the insights have been derived from industrial ecosystems (Bai, 2016; Decker *et al.*, 2000; Morris *et al.*, 2018), they consider the more complex urban environment and as such consist of a broader range of nonhierarchically related participants, including utilities, local government, city government, transportation authorities, service providers and consumer-citizen residents. As they focus on the built environment within which humans are dominant, urban ecosystems focus a greater variety of flows than industrial ecosystems, considering the flow of energy, capital, information and people. The system outcome for an urban ecosystem is urban amenity, including the sustainable delivery of societal activities, quality infrastructure and the physical environment as well as the sustainable production of goods and services.

Flow of knowledge

Beyond flows of energy and materials, other ecosystems studied by innovation scholars consider the production of knowledge within a geographically defined context (see Table 1). These types of ecosystems are increasingly being researched by innovation management and entrepreneurship scholars who wish to consider how local resources lead to new business models and new knowledge.

Entrepreneurial ecosystems. In entrepreneurial ecosystems, participants develop novel business models by cultivating a shared knowledge base regarding "what works" to harness advances in digital technologies (Autio *et al.*, 2018; Cohen, 2006). Consequently, the system-level outcome of entrepreneurial ecosystems is business model innovation instantiated as new ventures. Although entrepreneurial ecosystems are constrained to specific locations, ecosystem participants themselves are mostly focused on entrepreneurial opportunities outside the ecosystem (as opposed to being intrinsic to the ecosystem). Entrepreneurial ecosystems consist of venture capital (VC), educational and research institutions, and the government, as well as specialized participants that reflect their specific processes of business model experimentation and associated horizontal knowledge spillovers, such as new venture accelerators, coworking spaces and makerspaces.

Knowledge ecosystems. Knowledge ecosystems reflect the increasingly open processes of R&D and innovation and have the research and development of knowledge as their

Ecosystem category	Flow of energy and material		Flow of knowledge		Flow of value
Category description	Ecosystems that enable energy and material flows within a geographically defined context		Ecosystems that enable the production of knowledge within a geographically defined context		Ecosystems that enable the production of economic value
Ecosystem type	*Industrial ecosystem*	*Urban ecosystem*	*Knowledge ecosystem*	*Entrepreneurial ecosystem*	*Innovation, platform and business ecosystems*
Ecosystem outcome	Sustainable industrial production	Urban amenity	New knowledge	New business models	Value proposition
Location specificity	Location specific	Location specific	Mostly location specific	Location specific	Non-location specific
Ecosystem definition	Production of industrial goods and services in symbiotic collaboration	Collective production of urban amenity	Collective translation of advances in research knowledge into products and services	Collective facilitation of start-up and scale-up of entrepreneurial new ventures focused on business opportunities	Delivery of a value proposition through collaboration
Ecosystem participants	Manufacturers, service providers, resource providers, utilities	Utilities, local government, city government, transportation authorities, service providers, consumer-citizens residents	Universities, public research institutions, for-profit firms	Investors, accelerators, coworking spaces, makerspaces, educational and research institutions, government	Focal firm, complementors, suppliers, consumer-prosumers
Key source literature	Frosch and Gallopoulos (1989), Korhonen (2001), Lowe & Evans (1995)	Decker *et al.* (2000), Lovell and Taylor (2013)	Clarysse *et al.* (2014), Järvi *et al.* (2018)	Isenberg (2010), Autio *et al.* (2018)	Adner (2017), Iansiti & Levien (2004), Jacobides *et al.* (2018), Thomas & Autio (2020)

Source(s): Derived from: Aarikka-Stenroos *et al.* (2021)

Table 1. Overview of ecosystem types

system-level output (Bogers *et al.*, 2017; Järvi *et al.*, 2018; Von Hippel, 2007). In knowledge ecosystems participants collaboratively explore new knowledge about particular long-term goals (such as the circular economy, or sustainability) as their central activity and system-level outcome (Järvi *et al.*, 2018; van der Borgh *et al.*, 2012). Comprising regional research clusters consisting of nonhierarchically related participants, such as universities, public research institutions and for-profit firms (Clarysse *et al.*, 2014; Järvi *et al.*, 2018; Valkokari, 2015; van der Borgh *et al.*, 2012), most of the insights have been previously explored within the "systems of innovation" tradition over the past four decades (Lundvall, 2007; Malerba, 2002).

Flow of value

Beyond ecosystems that focus the flow of energy and materials and knowledge, a third category of ecosystems focuses on the flow of economic value between participants (see Table 1). These types of ecosystems are increasingly being researched by strategy and organizational theory scholars who wish to consider how local resources lead to new business models and new knowledge [1].

Innovation ecosystems. Derived from strategy research, an *innovation ecosystem* has a focal firm and a set of components (upstream) and complements (downstream) that support the focal firm to deliver a customer value proposition. Innovation ecosystems have a clear supply–push emphasis (Adner, 2017; Adner & Kapoor, 2010; Hannah & Eisenhardt, 2018; Jacobides *et al.*, 2018) but differ from conventional supply chains in that the value proposition depends on the availability of complementary products and services (Adner, 2017; Ceccagnoli, Forman, Huang, & Wu, 2012; Teece, 2018). Consisting of the focal firm(s) and immediately adjacent complementors and suppliers these ecosystems generally have (comparatively) a narrow scope. Innovation ecosystems generally represent the customer in abstract through their adoption and or acceptance of the ecosystem output, in the sense that the ecosystem output would not be viable if it did not meet specific customer needs.

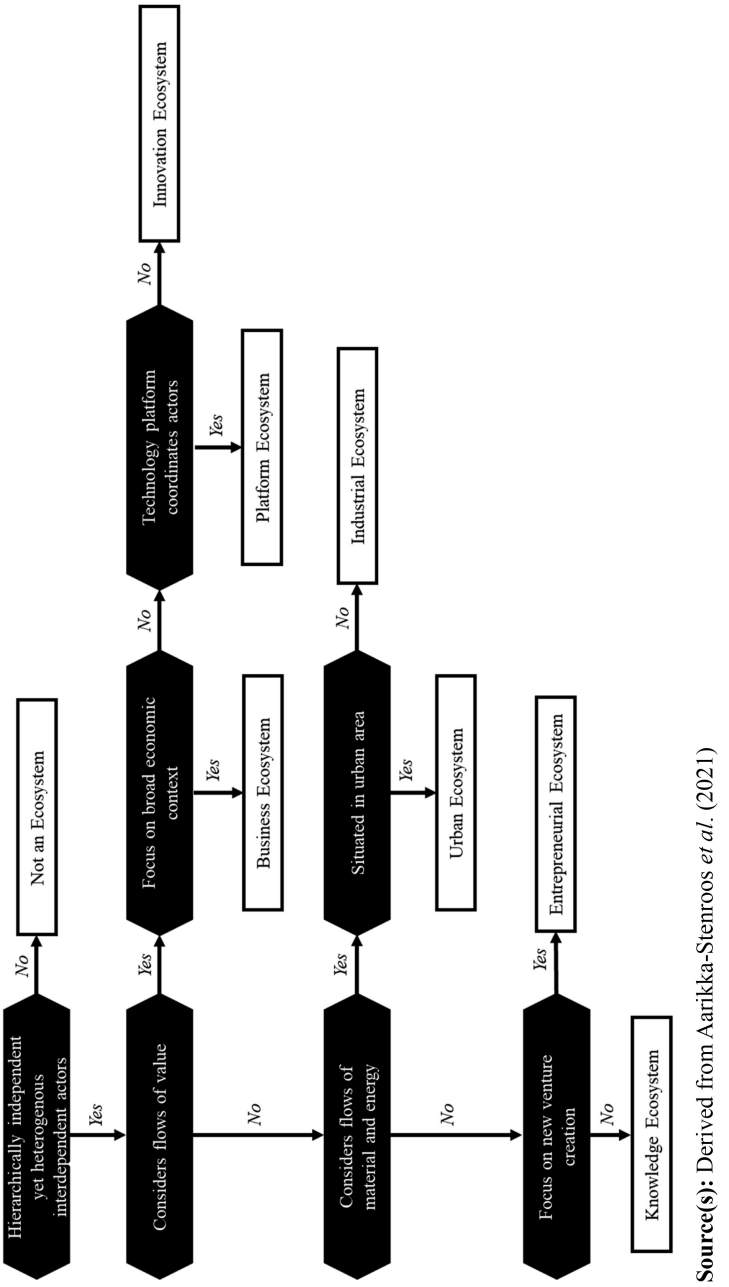
Platform ecosystems. In contrast to innovation ecosystem, *platform ecosystems* emphasize the role of technological dependencies and mostly focus on a shared connectivity interface broadly referred to as a "platform" (Thomas *et al.*, 2014). Although there has been some recent work considering organizations themselves as a platform (Lehtinen, Peltokorpi, & Artto, 2019; Thomas *et al.*, 2014), a platform ensures that a network of location-unbound complementors are able to create complements that enhance the output, particularly when accessible through the Internet (Ceccagnoli *et al.*, 2012; Gawer & Cusumano, 2008; McIntyre & Srinivasan, 2017). In platform ecosystems, there is a fundamental tension between the need for flexibility and variety vs the need for integrity and standardization which governance needs to address. While integrity helps align ecosystem participants to maintain the coherence of ecosystem outputs, flexibility allows them to generate variety (Wareham *et al.*, 2014).

Business ecosystems. Deriving from the initial formulations of Moore (1993) and Iansiti and Levien (2004), *business ecosystems* comprise the broad environment that a focal firm must monitor and react to (Thomas & Autio, 2020). However, business ecosystems do not make the explicit assumptions that characterize the other types of value flow ecosystems, and instead tend to be characterized by greater levels of fluidity, emergence and cocreation in the form of cocreated, yet emergent system outputs. In business ecosystems, there is more scope for innovation that potentially changes the roles and relationships among ecosystem participants, as participant roles often are less fixed than in the case of other flow of value ecosystems.

Future research directions

Having the correct conceptualization of an ecosystem is fundamental when researching innovation in ecosystem contexts. Given that ecosystems in innovation concepts vary by the type of flow they consider, their participants and their system-level outputs, it is vital that researchers ensure they are placing their research into the appropriate research to facilitate clear communication between scholars and to allow for cumulativeness and creativity (Suddaby, 2010). This is particularly important for scholars who wish to build theory using ecosystems (Bacharach, 1989, p. 498). For this reason, we include a heuristic that differentiates the different types of ecosystems that have been considered in the context of innovation (see Figure 1).

Our heuristic (see Figure 1) provides a clear exposition of the typology and is an easy to-use tool that assists scholars and practitioners in identifying different types of innovation



Source(s): Derived from Aarikka-Stenroos *et al.* (2021)

Figure 1.
A heuristic to disambiguate types of ecosystems

ecosystems they may come across, in understanding their individual characteristics, and to ensure that their research is cumulative. We also identify three main research directions for ecosystems generally.

How do different types of ecosystems interact?

Although we have presented the various ecosystems as distinct phenomena, many phenomena that innovation scholars may consider may include comprise elements from different types of ecosystems – such as development of an innovation ecosystem in the context of an entrepreneurial ecosystem or knowledge creation at the same time with an emerging circular economy business ecosystem. Given the complexity of some phenomena, such as the circular economy (Aarikka-Stenroos *et al.*, 2021), it may be that the different types of ecosystems may not be able to be isolated. This means that conceptual clarity is increasingly becoming a major challenge for innovation scholars. In trying to address these complex phenomena, scholars seem to be adopting the ecosystem moniker for phenomena that conflict with core ecosystem characteristics (see for instance "supplier ecosystems", Ozcan & Hannah, 2020), as well as merging different types of ecosystems (such as "civic entrepreneurial ecosystems", Sarma & Sunny, 2017). There are two aspects to consider here: First, which types of ecosystems are at most risk of conflation with existing well understood phenomena or other ecosystem types?; and second, how do two different types of ecosystems intersect, and what are their dynamics? While some scholars have begun to consider these in a rigorous way, such as Thomas, Sharapov, & Autio (2018), this is an area where there is an urgent need for future research.

How do ecosystems emerge?

There are surprisingly few studies that explore the processes of ecosystem emergence (for exceptions, see Dattée, Alexy, & Autio, 2018; Hannah & Eisenhardt, 2018; Snihur, Thomas, & Burgelman, 2018; Susur, Hidalgo, & Chiaroni, 2019). There are two broad schools of thought in this area, with one emphasizing collective emergence processes, under which the ecosystem gradually takes shape through multipolar interactions and negotiations among multiple heterogeneous participants (e.g. Dattée *et al.*, 2018; Sarma & Sunny, 2017; Susur *et al.*, 2019). Another approach with one emphasizing a "value blueprint" approach, under which a central participant defines an ecosystem blueprint and implements it (e.g. Adner, 2017; Hannah & Eisenhardt, 2018). Evidence suggests that both types of processes occur, yet we know little about the conditions under which either mode is more likely, and how context might influence the success of each mode.

How do ecosystems change?

We know that ecosystems change over time. Ecosystems "coevolve" (Basole, 2009; Moore, 1993) through a process where environmental changes and changes in the ecosystem participants mutually influence each other, prompting mutual adjustments (Lewin & Volberda, 1999; Merry, 1999; Van De Ven & Garud, 1994). However, while we have some theoretical work which starts to suggest some dynamics (for example, legitimacy, Thomas & Ritala, 2021), there are relatively few studies documenting how ecosystems evolve over time. In one portrayal, Ansari, Garud, & Kumaraswamy (2016) paint a long, gradually unfolding process of mutual negotiations and adjustments as a new disruptor gradually renegotiates participant roles in the industry architecture to create space for a new digital technology. More recently, García-Herrera & Autio (2020) have proposed an evolutionary template to consider architectural changes effected through ecosystem stakeholder relationships, highlighting the nature of mutualistic, communalistic, parasitic and predatory relationships in both core and peripheral relations. Given that ecosystems are organically

evolving structures, we believe much more can be done to understand how adjustments in dyadic relationships within an ecosystem architecture cascade to ecosystem-level phase changes, as well as the implications of these for strategy design within ecosystems.

How do ecosystems compete?

We know surprisingly little about how ecosystems compete. *This is particularly true for* spatially confined ecosystems, such as those that consider flows of materials, energy and knowledge. In these ecosystems, competition tends to be on the supply side rather than the demand side, as they are not exposed to specific market conditions determined by user choice. While has been systematic measurement (Stam, 2018) and ranking (Szerb, Ács, Komlósi, & Ortega-Argilés, 2015) of such ecosystems, mostly for the use of policy makers, this is remarkably unexplored. For non-location-specific ecosystems that consider flows of value, there has been more research (e.g. Cennamo & Santalo, 2013; Hannah & Eisenhardt, 2018; Kapoor & Lee, 2013). However, even with here, there is scope for more research. While ecosystems compete through mutual modes by emphasizing complementarities and mutual adjustments (Khanagha, Ansari, Paroutis, & Oviedo, 2020), others compete by locking in demand and appropriating users by increasing switching costs (Cennamo & Santalo, 2013). We suggest it would be worthwhile to study competitive interactions across ecosystems in greater depth to add nuance to the dominant, "winner take all" perspective to ecosystem competition.

We hope that this short paper can assist innovation scholars and practitioners to better understand the exciting phenomena that are ecosystems.

Note

1. A related concept is that of "technology ecosystems" (also sometimes called "digital ecosystems" and "software ecosystems"), which has been employed mainly in the information systems discipline. The usage of this concept overlaps with those of innovation ecosystems and platform ecosystems (see for instance Tiwana *et al.*, 2010; Wareham *et al.*, 2014).

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Corresponding author
Llewellyn D.W. Thomas can be contacted at: LThomas@iese.edu

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